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ABSTRACT

GRADES OR AGES: No mention; appears to be for secondary grades. SUBJECT MATTER: Physical sciences for slow learners. ORGANIZATION AND PHYSICAL APPEARANCE: The guide is divided into 11 units, each of which is further subdivided into several chapters. Each chapter is laid out in three columns; column headings are concepts, content, and activities. The guide is mimeographed and spiral-bound with a paper cover. OBJECTIVES AND ACTIVITIES: No specific objectives are mentioned. Each activity or group of activities in a chapter is related to a specific concept. Most activities consist of simple laboratory experiments to be demonstrated by the teacher. A few of the experiments are to be done by students with the aid of the teacher. Textbook assignments are coordinated with specific demonstrations. INSTRUCTIONAL MATERIALS: Very few materials are listed, other than those needed for laboratory demonstrations. These are listed with each experiment. Some chapters coordinate films with other activities. STUDENT ASSESSMENT: No mention. (RT)

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JUNE, 1970

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FOREWORD

This experimental edition has been developed for the use of physical science teachers in the instruction of basic students. A variety of activities have been listed for each unit in an effort to promote student involvement.

Teachers using this guide are urged to make pencil notes wherever additons and deletions are felt necessary - particularly the addition of activities. These notes will be helpful in developing a supplement and/or preparing future revised editions.

This guide, developed by Mr. Robert Goss, Junior High School Principal, and Mr. Phillip Jones, Physical Science Teacher, during the 1970 Curriculum Workshop Sessions, is not a prescription but a curriculum model containing suggestions for teachers.

Expressions of appreciation are extended to the personnel who developed the guide. Much credit is due to Mrs. Karen Sue Allen, the Coordinator of Curriculum. Because of the sturdy support of the Superintendent, E. H. McKenzie, Jr., and the Nederland Board of School Trustees, curriculum guides in all subject areas are being developed.

Curriculum work has not only been purposeful and serviceable for the Nederland School District, but requests have been received from many schools throughout the United States and Canada. Nederland curriculum guides are listed in the Association for Supervision and Curriculum Development catalog.

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I. PHILOSOPHY OF THE INSTRUCTIONAL PROGRAM

Whatever we do in Nederland's instructional program depends upon what we think children are like. The goals we seek, the things we do, the judgments we make, even the experiments we are willing to try, are determined by our beliefs about the nature of a child and his capacities. If we recognize that children are uniquely different - in physical growth, in intellectual power, in social maturity, in readiness, in ability to learn, in any human attribute - then every effort should be made to provide a personalized educative experience for each child.

This personalized educative experience can be an attainable goal - even though it seems unreachable at times - under the following conditions:

Children Are Different	1. Instructional arrangements are based on the fact that children move toward maturity at diverse and uneven rates of progress;
Continuous Progress	2. Though diverse and uneven, the movement toward maturity is permitted to be a continuous movement - a movement unhindered by unnecessary repetition of subject matter, rigid instructional arrangements, and an evaluation of a child's progress based on arbitrary measures of promotion;
Teachers Are Different	3. The variability in the instructional staff, i.e., marked differences in experience, philosophy, and competence, is considered as an asset rather than as a liability through effective and efficient staff utilization practices; and
Organizing For The Individual	4. The pacement of a child is conceived as a flexible arrangement for providing him personalized educative experience. Grouping arrangements are considered as fluid and flexible patterns of organization by administrative, supervisory, and instructional personnel.

We believe that every child should have the opportunity to experience some success in accordance with his abilities. In brief, we hope to reduce the necessity of repetition of materials and to reduce the gaps in the learning experiences of each child. We feel that this can best be done in an evironment as described in the above paragraph.

We further believe that the objectives of the instructional program shall be compatible with the instructional philosophy.

Board Action - December 14, 1964

II. OBJECTIVES OF THE INSTRUCTIONAL PROGRAM

The objectives of the instructional program can be stated best by describing the function of the school, the means of fulfilling the function, the organizational structure, the provisions for individual differences, and the type of pupil progress needed.

School Function: The schools shall be learner centers - designed to provide a personalized educative experience for each child. Every effort shall be made by the professional staff to develop the learner as an individual and as a member of society. The needs of the individual will determine the type and amount of subject matter to be covered.

Means of Fulfilling Function: The focus of the instructional program shall be on ways of knowing and thinking. The emphasis will be on the individual. Subject matter will be molded into an instructional pyramid which shall consist of three parts: basic instructional activities, enrichment activities, and extra-curricular activities. Activities directly related to each part of the pyramid will be stated in terms of sequential patterns of learning. These sequential patterns are designed to serve as dimensions in learning and to provide broad guidelines for the professional staff. These patterns will reflect a broadening of activities from the beginning point of the pyramid and continuing on an infinite basis.

Organizational Structure: A graded structure is considered to provide a framework for administrative operations. However, a graded structure shall not be construed to be a device which would restrict the progress of the child nor limit the instruction to be offered.

The vertical direction of the structure shall provide for the continuous, unbroken progression of all learners, with due recognition of the wide variability among learners in every aspect of their development.

The horizontal direction of the structure shall permit flexibility in assigning pupils to instructional groups that may range in size from one pupil to as many as a hundred or more.

Provisions for Individual Differences: Individual differences in many aspects of development shall be recognized by the professional staff and used in planning highly individualized programs.

Type of Pupil Progress Needed: Provision shall be made for both differentiated rates of progress and variations in kinds of programs, according to individual needs and abilities. Insofar as possible, each student shall have an instructional pyramid designed for him.

Board Action - December 14, 1964

III. INTRODUCTION

The following is a basic outline of a possible course of study for a class of slow learners. It was prepared using Physical Science - A Modern Approach as a reference and follows the general outline of this book. Some sections of the book are omitted and some may be covered in a different order from that of the book.

All page numbers and chapter numbers refer to Physical Science - A Modern Approach, unless otherwise stated. Films may be obtained from the Region V Film Service unless otherwise indicated.

Sections of this guide that are marked "demonstrations" are intended to be teacher demonstrated or to be demonstrated by a student. Sections that are marked "laboratory" should be done by students individually or in small groups. It is intended that all lab and demonstration work be drawn and written up by the students to be kept in a notebook or folder.

Questions for each chapter have been indicated and should be answered individually by students and discussed in class.

As a pilot program for basic students this guide should be supplemented or altered if a situation requires such. Any additional lab or demonstration work or good audio visual aids should be added in the appropriate section in order to improve the guide for future use.

UNIT ONE - CHAPTER 2 - MEASUREMENT

CONCEPTS	CONTENT	ACTIVITIES
. The two most widely used systems of measurement in the world are the Metric and English systems.	. Compare basic metric units with basic English units.	Demonstration . Pour a quart of water into a liter container. . Compare a yard to a meter. . Compare a one pound weight to a one gram weight.
. The metric system is used in most scientific work.		
. Prefixes are used in forming metric units. . The basic unit of length is the meter.	. Disucss linear measurement in the metric system. Give the basic unit (meter) and discuss the use of the prefixes milli, centi, and kilo. Compare the different units that are formed by these prefixes . Give abbreviations of the following: . Meters - m . Centimeters - cm . Millimeters - mm . Kilometers - km	Laboratory . Provide several wooden blocks of various sizes. Have each student measure the length, width, and height of a block. . Record answers in cm and mm. Demonstration . Use a meter stick to measure the length and height of the chalk board. . Record results on the board in meters, cm, mm, and convert to km. Test . Devise a test for linear measurement. Use an activity as part of the test. Have each student measure a numbered block and record the results in cm and mm.

CONCEPTS	CONTENT	ACTIVITIES
. The basic unit of weight in the metric system is the gram.	. Discuss the units of weight that are formed by using prefixes with the term "gram."	Laboratory . Obtain a roll of new nickels from the bank and have each student weigh one. (It should weigh 5 gm.) . Have each student weigh 1/4 sheet of typing paper. . Have each student weigh a one pound weight Demonstration . Weigh a quantity of water and add 5 gm of salt to it. Discuss the combined weight of the two substances and then weigh them.
. The basic unit of volume in the metric system is the liter. . The volume of solids are usually found in cubic centimeters (cc). . One cc is equivalent to one milliliter.	. Discuss the metric units of volume that are formed by using prefixes with the unit "liter." . Discuss and illustrate on the board the correct procedure for reading a graduated cylinder.	Laboratory . Give each student a volume of water and have him use a graduated cylinder. Record results in liters and milliliters. . Each student should compute the volume of a block of wood in cc. Record the length width and height of the block in cm. . Give each student an object with an irregular shape. Have him find its volume by immersing it in water and measuring the volume of the water that was displaced. Record the result in ml and convert this into cc. Demonstration . Determine the volume of the lungs of a student by having him blow into an inverted container of water. Measure the amount that is displaced.

CONCEPTS	CONTENT	ACTIVITIES
. Density is the weight of a given volume of a substance.	. Define and discuss density. Relate this to the fact that some things will float in water and some things will not float.	Test . Devise a test over weight and volume in the metric system. Laboratory . Refer to attached procedure sheet on "Density." . Have each student complete this sheet. From the Textbook . Page 22 - Have students answer question 4. . Page 23 - Do activities 1 and 8. Test . Devise a test over metric system.

DENSITY

I. Introduction:

Density is the weight per unit volume. We can determine the density of a sample by determining its weight and volume. The weight divided by its volume will give the density.

The volume of regular objects may be determined by measurement of its dimensions and calculating its volume by use of the proper formula. The volume of a rectangular block is length times width times height. $V = l \cdot w \cdot h$. The volume of a cylinder is the area of the base times the height. $V = \pi r^2 h$.

To determine the volume of an irregular object such as a rock, the rock may be placed in a graduated cylinder partly filled with water and noting the increase in the volume of water in the graduate cylinder. This increase will be the volume of the rock.

In this experiment you will use a hand balance to weigh the objects. This type of balance is inexpensive; balance and weights will cost less than $10.

II. Materials Needed:

Wood block, wood cylinder, stone, hand balance, set of weights, ring stand, test tube clamp, metric ruler, 100 ml graduate.

III. Procedure:

Weigh the three objects with your hand balance. The objects include a wood block, a wood cylinder, and a rock. Measure the wood block and wood cylinder. Put about 50 ml of water in the graduate and read the volume accurately. Now turn the graduate side ways and slide the stone down the wall and into the water. Dropping the stone may splash out the water or break the glass cylinder.

Read the new volume and record all data below.

Wood Block

Weight _____ grams

Length _____ cm

Width _____ cm

Height _____ cm

Volume _____ cc

Density = $\frac{\text{Weight}}{\text{Volume}}$ = _____ g/cc

Stone

Weight _____ grams

Final volume of water _____ ml

Initial volume of water _____ ml

Volume of water _____ ml

Density = $\frac{\text{weight}}{\text{volume}}$ = _____ g/ml

(1 ml is equal to 1 cc)

Water

Volume 100 ml

Weight _____ g

Density _____ g/ml

Density = $\frac{\text{weight}}{\text{volume}}$

CONCEPTS	CONTENT	ACTIVITIES
. Energy is the ability to do work. . The two kinds of energy are potential and kinetic. . Potential energy is energy at rest.	. Define and discuss energy and give several examples of objects that contain or use energy. . Discuss and define potential energy.	From the Text . Read "experiments" page 77. . Page 78 - Answer questions 4 & 10. . Page 78 - Do activities 1 & 4. Film . Energy and Work Demonstration . Make a catapult from a ruler with the fulcrum in the center. Place a sponge on one end and demonstrate the potential energy of an object by dropping it from various heights onto the other end of the ruler. Activity . Have students make a list of several materials with potential energy.
. Kinetic energy is energy due to motion.	. Define and discuss kinetic energy. . Give several examples of objects with kinetic energy. Discuss the transformation of potential into kinetic energy.	Demonstration . Use the same demonstration that was used for potential energy. . Show transformation of energy by shooting a paper wad with a rubber band. The potential of the stretched rubber band is transformed into the kinetic energy of the paper wad. . Construct two pendulums so that they touch each other. Show that one pendulum set into motion will transfer energy to the other pendulum.

CONCEPTS	CONTENT	ACTIVITIES
		From the Text . Page 90 - Experiment 2 . Page 90 - Questions 2, 10, 11, 12
. A gas is made up of molecules that are in constant motion.		Films . Air All Around Us . Air and What It Does . Gas Pressure and Molecular Collisions
. Gas pressure is due to the motion of gas molecules.	. Discuss the fact that air can hold up the weight of an automobile.	Demonstration . Determine (by measuring) the number of square inches of tires that touch the ground for a car. Use the approximate weight of the car to determine the number of pounds per square inch that will hold the car up.
. Temperature, concentration of molecules, and the type of gas affect the pressure of a confined gas.	. Discuss the zig-zag movement of gas molecules, and the factors that affect the pressure of an enclosed gas.	
		Test . Cover Forms of Energy and Properties of Gas.

CONCEPTS	CONTENT	ACTIVITIES
. The atmosphere is made up of gases. . The atmosphere exerts a pressure of 15 lb/in^2, on all things and in all directions.	. Define and discuss atmospheric pressure. List several things that depend upon atmospheric pressure such as water pumps, drinking straws, barometers, etc.	Demonstration . Heat a one gallon tin can with the lid off. Remove the heat and replace the lid and cool the can. . Construct a mercurial barometer from glass tubing (3 ft.), mercury, a pan, and a ring stand. Explain its operation. . Demonstrate and explain why a drinking straw works.

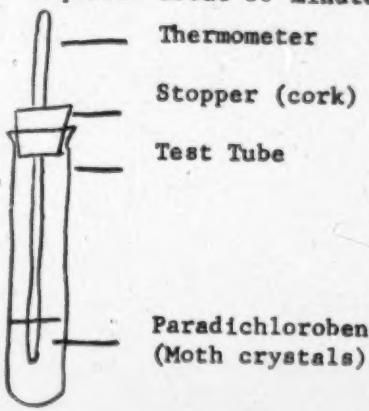
CONCEPTS	CONTENT	ACTIVITIES
		From the Text . Page 105 - To Make a Diver (experiment) . Page 106 - Questions 8 & 14
. Liquids can be poured.		
. The pressure of a liquid varies with its depth. The pressure increases uniformly as the depth increases.	. Discuss and define water pressure.	Demonstration . Punch holes in a can at different heights. Pour water into the can and discuss why the stream at the bottom is stronger than the one above it. . Prepare a simple manometer (page 95) and show that pressure increases with depth but is equal in all directions.
	. Discuss the transmission of forces in a liquid and relate this to the construction of a dam such as Sam Rayburn or Toledo.	
. Pressure exerted upon a liquid is transmitted through the liquid in all directions.	. Explain the operation of a hydraulic system, using a hydraulic lift, a hydraulic jack, a hydraulic press, and a hydraulic brake system (page 77) as examples.	
		Test . Devise a test covering atmospheric pressure, properties of liquids and hydraulic systems.

CONCEPTS	CONTENT	ACTIVITIES
. The kinetic theory states that all molecules are in constant motion.	. Discuss the kinetic theory and give several cases which show that molecules are in motion.	From the Text . Page 119 - Questions 5, 6, 19 Demonstration . Drop food coloring into a glass of water and notice that it spreads out. . Repeat this in a glass of hot water and compare the two. Laboratory . Have students construct a Galileo air thermometer (page 109) and place hot and cold objects on it. Explain what happens.
	. Compare the centigrade and fahrenheit temperature scales. . Define and discuss btu and calories. Use simple math to demonstrate them.	Laboratory . Take the temperature of 300 ml of water in °C and °F. Heat it for 3 minutes and take the temperature again. Weight the water and compute the btu's and calories that it absorbed.

CONCEPTS	CONTENT	ACTIVITIES
. Matter will expand when heated and contract when cooled.	. Relate the kinetic theory to the expansion of matter. The faster the molecules move, the harder they collide with each other.	From the Text . Page 133 - Questions 2, 3 . Page 134 - Activity 3 Demonstration . Demonstrate the ball and ring experiment. . Show that air expands by loosely placing a solid stopper in a large test tube and gently heating the tube.
	. Discuss thermostats, thermometers, blinkers for Christmas lights and other common applications of the bimetal strip. Explain why it works.	Laboratory . Show the expansion of water. Refer to page 127. . Heat a bimetal strip and then cool it. Test . Devise a test for Chapters 9 & 10.

CONCEPTS	CONTENT	ACTIVITIES
		From the Text . Page 147 - Questions 8 & 14. . Page 147 - Activities 4.
. Conduction is the transfer of heat by impact of molecules.	. Discuss conduction and give several examples of it.	Demonstration . Hold copper gauze over a bunsen burner flame. Explain why the falme doesn't go through. Explain a "Davies Safety Lamp" as used in coal mines that work on the same principle. . Wrap paper around a rod of half wood and half copper. Heat the paper with a burner. Laboratory . The "Conductivity of Water" Refer to pages 137 and 138.
. Convection is the transfer of heat by fluid currents.	. Discuss convection currents. Relate these to convection heating systems and sea breezes. Refer to the beach.	Demonstration . Construct a smoke boy (page 139) and explain how it works. Laboratory . To show convection in water place potassium permanganate crystals near the side of a beaker of cold water and heat the water under the crystals.

CONCEPTS	CONTENT	ACTIVITIES
. Radiation is the transfer of heat through space.	. Discuss radiation and how we receive it from the sun.	Demonstration . Place a lightbulb near a radiometer and explain what happens. . Have a student hold one hand above and one hand below a light bulb and explain what happens. Test . Devise a test for Chapter 11.

CONCEPTS	CONTENT	ACTIVITIES
. Matter must absorb or give up energy in order to change states.	. Discuss the process of changing from one state to another. Introduce heat of fusion and heat of vaporization. . Work simple problems with heat of vaporization and heat of fusion.	From the Text . Page 160 - Questions 12, 15, 16. . Page 160 - Activities 1. Demonstration . Place ice on a students hand to show that it absorbs heat as it melts. Laboratory . Heat moth crystals until they melt. Record the temperature each minute as they cool back to a solid. Note the temperature at which heat of fusion is given off. This requires about 30 minutes to do. 
. Evaporation is a cooling process because the high energy molecules escape the surface tension.	. Discuss evaporation and give several examples illustrating that it is a cooling effect. . Discuss refrigeration in relation to vaporization and evaporation.	Laboratory . Refer to attached procedure sheet "Evaporation," at the end of this unit.

CONCEPTS	CONTENT	ACTIVITIES
. The water cycle involves the processes of evaporation, condensation, and precipitation.	. Discuss the "water cycle" in nature. Explain the condensation of water on windows and the possible "rain" in the Astrodome.	Demonstration . Boil some water and hold a piece of cool glass over it to show evaporation and condensation.
. Boiling occurs when the vapor pressure of a liquid is equal to the pressure on the surface of the liquid.	. Discuss the boiling point of liquids and relate this to atmospheric pressure at different altitudes and boiling point.	Laboratory . Boil some water and find its boiling point. Explain why it doesn't go higher. . Hold a thermometer above some boiling water to measure the temperature of the steam. . Boil water under reduced pressure. Refer to page 159.
. An increase in atmospheric pressure increases boiling point.	. Discuss the pressure cooker. Relate this to low and high altitude cooking.	
. Humidity is the amount of water vapor in the air.	. Discuss humidity and relative humidity.	Demonstration . Demonstrate the use of the hygrometer in finding relative humidity. Test . Devise a test for Chapter 12.

EVAPORATION

I. Introduction:

Liquids with low boiling points have high vapor pressure and conversely high boilers have low vapor pressure. We will thus note that low boiling point liquids are quite volatile.

When liquids evaporate they cool the surface from which they evaporate. We will in this experiment observe the cooling which occurs when three different liquids evaporate.

II. Materials Needed:

100 ml beaker, thermometer, 3 cottom wicks that slip over the bulb of a thermometer (use old stretchy cotton shorts, fold over, and sew to make a narrow seam), three bottles containing volatile liquids such as acetone, isopropyl alcohol, and water.

III. Procedure:

Read the room temperature with a dry thermometer. Place one of the cotton wicks over the bulb and dip into one of the liquids. Watch and record the lowest temperature reached by the thermometer (2 or 3 minutes will be long enough).

Remove the wet wick and place in the 100 ml beaker. Repeat the procedure with dry wicks using the other two liquids. Record the data below:

	Temperature °C
Dry Thermometer	_____
Wet wick using water	_____
isopropyl alcohol	_____
acetone	_____

CONCEPTS	CONTENT	ACTIVITIES
		From the Text . Page 175 - Questions 2, 10, 19 Films . Introducing Chemistry . Introducing Chemistry - Types of Chemical Changes. . Combustion . Combustion - An Introduction To Chemical Change . Fire and Oxidation
. Air is composed of approximately 78% nitrogen and 21% oxygen.	. Discuss the composition of air.	Demonstration . Use rusting iron to remove the oxygen from a sample of air. Refer to page 165.
. Oxygen supports combustion but will not burn.	. Discuss the chemical and physical properties of oxygen and give several uses of it.	
. Oxygen can be prepared by decomposing several compounds.	. Discuss the preparation of oxygen on a major scale by cooling air. . Discuss laboratory preparation of oxygen by heating potassium chlorate.	Laboratory . Prepare and collect oxygen by heating potassium chlorate. . Test the properties of the collected oxygen with a glowing stick.
. Oxygen reacts with many different substances.	. Discuss oxidation reactions and common uses of oxygen.	Demonstration . Heat potassium chlorate with and without manganese dioxide to show the effect of a catalyst. Test . Devise a test for Chapter 13.

CONCEPTS	CONTENT	ACTIVITIES
		From the Text . Pages 185-86 - Questions 5, 17. . Page 187 - Activities 1. Film . Hydrogen, Wonder of Water
. Hydrogen is a very reactive gas that burns with a hot flame.	. Discuss hydrogen as a gaseous element giving the chemical and physical properties of it.	Laboratory . Prepare hydrogen gas by displacing the hydrogen in a dilute acid with an active metal. Collect the hydrogen and test its properties with a burning wooden stick. Refer to page 178. Demonstration . To prove that the burning of hydrogen produces water, ignite escaping hydrogen gas and hold a dry test tube over the flame. (Note: A mixture of hydrogen and air explodes.) Refer to page 179.
. Water is a compound that is made up of twice as much hydrogen as oxygen.	. Discuss water as a compound of hydrogen and oxygen. Give several examples of how water is important to man. Illustrate on the board the reaction between hydrogen and oxygen.	Demonstration . Set up an electrolysis apparatus and collect a test tube of oxygen and one of hydrogen. Test them with burning and glowing splints to prove what they are. Test . Devise a test over Hydrogen and Water.

CONCEPTS	CONTENT	ACTIVITIES
		From the Text . Page 205 - Questions 6, 18. Film . Refinery Processes - Obtained from Shell Films
. Coal was formed from living plants under warm, moist climates.	. Discuss and list conditions for the formation of coal from organic compounds.	
. Coal can be broken up to form many products.	. Discuss the destructive distillation of coal and list the products obtained and their uses.	Laboratory . The Destructive Distillation of coal, Destructively distill some soft coal (use wood if no coal is available) and note the solid, liquid, and gas that are formed. Burn the gas. Refer to page 197.
. Petroleum was formed from plants and animals that lived in the sea. It is made up of many compounds.	. Discuss the formation of Petroleum. Define and discuss fractional distillation of crude oil and give uses for each fraction. Show the difference between the fractions by drawing structural diagrams of the molecules on the board, showing that short chains burn the easiest. . Discuss cracking.	Demonstration . To demonstrate fractional distillation conduct experiment 16-2, page 199. . Have students draw structural diagrams of molecules. Demonstration . Cracking - Refer to demonstration on page 266 (Fig. 26-15), in Physical Science a Basic Course.

CONCEPTS	CONTENT	ACTIVITIES
. An internal combustion engine burns fuel to produce motion.	. Discuss the operation of an internal combustion engine. Show parts of a cut away lawn mower engine.	Demonstration . Have student or students describe operation of each part of the engine. . Students observe actual car engine, a six and eight cylinder. Point out the parts of the engine that can be seen. Test . Devise a test for Chapter 16.

CONCEPTS	CONTENT	ACTIVITIES
. Carbon dioxide is a stable compound that will not burn nor support combustion.	. Discuss the physical and chemical properties of carbon dioxide, how it can be prepared, and its uses to man.	From the Text . Page 213 - Question 16. Laboratory . The preparation of Carbon Dioxide. Prepare carbon dioxide using either marble chips and acid or baking soda and dilute acid. Collect it by displacing air. . Test the carbon dioxide with a burning splint. . Test the carbon dioxide with limewater. . Test the carbon dioxide with litmus paper and water. Demonstration . Balance a 1000 ml beaker on a triple beam balance. Pour baking soda and dilute hydrochloric acid into a second beaker and pour the resulting carbon dioxide into the balanced beaker. . Prepare carbon dioxide in a 1000 ml beaker using baking soda and dilute hydrochloric acid. Pour this down a wooden trough (built out of two 6" x 24" boards) in which candles have been placed about 6" apart and lit. The candles will be extinguished as the CO_2 reaches them.

CONCEPTS	CONTENT	ACTIVITIES
. We use oxygen and give off carbon dioxide in the process of respiration.	. Discuss respiration and the gaseous exchange of oxygen and carbon dioxide.	Demonstration . Use a straw to blow into a container of limewater and note the white precipitate that forms.
. Carbon monoxide is a very poisonous gas because it is chemically active.	. Discuss carbon monoxide as a chemically active compound that is poisonous to us because of its reacts with hemoglobin of the blood.	
		Test . Devise a test for Chapter 17.

CONCEPTS	CONTENT	ACTIVITIES
		Film . Atomic Energy - Inside the Atom
. An atom is a small particle that is made up of even smaller particles.	. Discuss and define matter, and electrical charge. Name the three main particles of an atom and give the weight and charge of each.	
	. Discuss and define atomic weight and atomic number. Explain Bohr's model of atoms.	Demonstration . Have students draw diagrams of models of Bohr atoms for the first twenty elements.

CONCEPTS	CONTENT	ACTIVITIES
. The periodic table groups elements that are similar in properties.	. Discuss the following: . Atomic Number . Atomic Weight . Electron Configuration	

CONCEPTS	CONTENT	ACTIVITIES
	. Supply help if needed. Complete work in class. . Discuss answers to questions on page 257.	From the Text . Page 257 - Questions 1-20. Film . <u>The Drama of Metal Forming</u> - from Shell Films Test . Devise a test for Chapters 18, 19, 21.

CONCEPTS	CONTENT	ACTIVITIES
. Atomic radiation is the emission of particles or rays from an atom.	. Explain and define alpha, beta and gamma radiation with atom structure. . Determine the background count. . Aluminum filtering and graphing . Repeat aluminum filtering . Distance . Backscattering	

*This is a demonstration unit and can only be done with the proper equipment and knowledge of the subject.

CONCEPTS	CONTENT	ACTIVITIES
		From the Text . Page 296 - Questions 10, 15. Film . Magnetic Force
. Magnetism is a force that will attract or repel other forces.	. Discuss and define magnetism. State the law of magnetism and the domain theory.	Demonstration . Suspend a bar magnet so that it is free to turn. Move the N-pole of another magnet near the N-pole of the suspended magnet. . Make a magnet by rubbing another magnet.
. A magnetic field is the area around a magnet.	. Discuss magnetic field and magnetic lines of force.	Demonstration . Melt some paraffin in a pan and dip a sheet of paper in it. Let the paraffin harden on the paper and place it over a magnet. Sprinkle iron filings over the paper to show the magnetic field. Carefully lift the paper, without distrubing the filings, and hold it over a lightbulb until the paraffin melts and holds the filings.
. The earth has a magnetic field.	. Discuss the earth as a magnet and diagram its magnetic field on the board.	

CONCEPTS	CONTENT	ACTIVITIES
		From the Text . Page 305 - Questions 7, 14. Films . Lightning and Thunder . Electrostatic Charges and Forces
. Static electricity is an accumulation of electrical charge.	. Discuss electrical charge and static electricity. State the law of charges.	Demonstration . Have students list as many instances of static charge as they can and tell what caused them. Example: Friction between shoes and a wool rug. . Demonstrate how an electroscope works. . Charge one end of an ebonite rod and suspend it so that it is free to turn. Charge a second ebonite rod and move it near the suspended rod. Finally charge a glass rod and move it near the suspended ebonite rod.
. An electroscope is a device for detecting small charge.	. Discuss how the electroscope can be used to determine what charge is on a body.	Demonstration . Charge an electroscope negative by touching the knob with a charged ebonite rod. Charge a glass rod and move it near the knob of the electroscope.

CONCEPTS	CONTENT	ACTIVITIES
. An object can be charged without toughing it.	. Discuss charging by induction.	Demonstration . Charge an ebonite rod (or comb). Open a faucet until a small stream of water is falling. Hold the ebonite rod near the water and note that the water curves toward the rod. . Charge a balloon by rubbing it with fur. Show that it will stick to the wall. Test . Devise a test for Chapters 24 and 25.

CONCEPTS	CONTENT	ACTIVITIES
		Films . Electricity - How to Make A Circuit . Electricity From Chemicals . Learning About Electric Currents
. Current electricity is a flow of electrons.	. Define and discuss current electricity alternating current, and direct current. Give sources of alternating and direct current.	
. A cell is a device that produces or stores electricity.	. Discuss wet and dry cells.	Laboratory . Have students construct a lead storage cell from two strips of lead, a beaker, and dilute sulfuric acid. It can be charged using a dry cell battery. (See attached sheet "How a Car Battery Works") . Measure the voltage of the charged cell. Demonstration . Construct a simple voltaic cell from copper, zinc, sulfuric acid, and a beaker. . Measure the voltage.
. Electricity can be measured.	. Define and discuss the units of electricity. Relate volt, amp, ohm, and coulomb to each other.	Demonstration . Measure the voltage of a dry cell. . Measure the current of a dry cell. . Put a resistor in the circuit and show that the current is affected by again measuring the current. This can be done with a variable resistor such as a rheostat.

CONCEPTS	CONTENT	ACTIVITIES
. Batteries can be connected in two different ways to achieve two different things.	. Discuss parallel and series circuits with batteries.	Demonstration . Measure the voltage and amperage of two dry cells. Connect them in series and measure the voltage and amperage. Connect them in parallel and measure the voltage and amperage. Test . Devise a test for Chapter 26.

CONCEPTS	CONTENT	ACTIVITIES
		From the Text . Page 330 - Questions 11, 14.
. Wires of different sizes and lengths have different resistances.	. Discuss the relationship between the size of a wire, the length of a wire, the type of wire and the amount of heat produced when placed in an electrical circuit.	Demonstration . Connect a small piece of nichrome or tungsten (from a light bulb) across the electrodes of a dry cell and note the temperature. Repeat with a piece of similar size copper wire.
. Heat and light can be produced from electricity.	. Discuss electrical heating and electrical lighting.	Demonstration . Take a lightbulb apart to show the parts. . Take an electric iron or toaster apart to show how it works.
. A fuse is a safety device.	. Discuss fuses.	Demonstration . Refer to activity "The Function of a Fuse in a Circuit," page 331 in the text. Test . Devise a test for Chapter 27.

CONCEPTS	CONTENT	ACTIVITIES
		From the Text . Page 349 - Questions 10, 22.
. Electrical and magnetic fields are similar and one can be produced from the other.	. Discuss the relationship between an electrical field and a magnetic field.	Demonstration . Connect a wire to three dry cells in series. Hold a section of the wire parallel to a compass needle. . Refer to experiment 28-2 on page 334 in the text.
. An electric field can be used to induce magnetism into a piece of metal.	. Discuss electromagnets and why a coil of wire magnetizes metal if a current is passed through the coil.	Demonstration . Produce a permanent magnet from a coil of wire as in experiment 28-4 on page 336 in the text. . Make an electromagnet from a nail, a coil of wire, and a dry cell. Show that the strength of the magnet can be increased by adding another cell to the apparatus or by increasing the number of turns of wire on the nail.
. A magnetic field can be used to produce an electrical current.	. Discuss induced current in relationship to electric motors and generators. Explain why generators produce a current.	Demonstration . An Induced Current. Refer to experiment 28-6 on page 338 in the text. . Obtain an old generator or starter motor from an automobile. Disassemble it and show the parts and have a student explain the function of each. Test . Devise a test for Chapter 28.

CONCEPTS	CONTENT	ACTIVITIES
		From the Text . Page 360 - Question 6.
. An electrolyte is a substance that will conduct a current when in solution.	. Discuss the conductivity of various substances and relate them to electrolytes and nonelectrolytes.	Demonstration . Prepare several different types of solutions. Connect a bulb in a circuit so that one wire can be cut and inserted into the solutions. The bulb should burn if the solution is an electrolyte. Test the bulb on several solids such as sugar, salt, mercury, and wood. Refer to experiment 29-1 on page 351 in the text.
. Electricity can be used to decompose compounds and to plate metals onto object.	. Define and discuss electrolysis and electroplating. Relate this to the plating of automobile parts, silver spoons and gold and silver jewelry.	Demonstration . Electroplate a spoon using copper sulfate and a piece of copper metal. Test . Devise a test for Chapter 29.

HOW A CAR BATTERY WORKS

I. Introduction:

In this experiment we will show how a lead storage cell may be charged up and then discharge it through a little light bulb. Although the students do not need to know all the chemistry of this reaction, it is given below for your information.

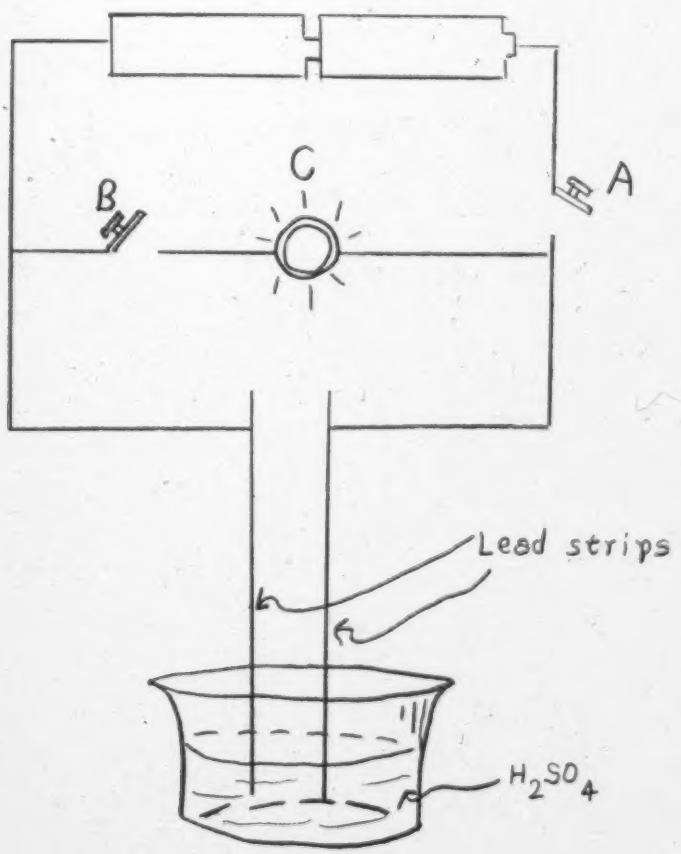
$$2PbSO_4 + 2H_2O \underset{\text{Charge}}{\overset{\text{Discharge}}{\rightleftharpoons}} Pb + PBO_2 + 2H_2SO_4$$

II. Materials Needed:

100 ml beaker, 2 lead strips, 3 M H_2SO_4, 2 small clamps, 2 ring stands, 2 volt bulb and socket, 2 - 1.5 volt batteries, battery holder, 2 switches, 2 alligator clamps, electric wire, board to mount equipment.

III. Procedure:

Mount the equipment as schematically diagrammed below:



When switch A is closed the lead cell will be charged by the battery. After charging for a certain length of time, take your finger off the switch and open the circuit. Now close switch B and the light bulb will burn. Time the charge and discharge and record below as indicated.

Time to charge lead cell.	Light burns for how many seconds?
60 seconds	
120 seconds	
240 seconds	

CONCEPTS	CONTENT	ACTIVITIES
		From the Text . Page 38 - Questions 10, 11. Film . How Simple Machines Make Work Easier
. Work is done when a force is exerted through a distance.	. Define and illustrate force and work.	Demonstration . Use a spring balance to lift an object and to slide an object horizontally. Show that a force is required to move the object in both cases. . Have a student lift a pencil from the floor to a table top. Have another student lift a book the same distance. Have the students determine who did the most work and then relate the terms force and distance to work.
. Friction is a force that opposes motion.	. Discuss friction and how it affects the work that can be done by a man or a machine.	Demonstration . Use a spring balance to drag an object across the table top. Lubricate the table top with a light oil and once again pull the object across the table.
	. Compute simple work problems by multiplying the force applied, times the distance that an object is moved.	Activity . Duplicate problems for students to work individually and keep in a notebook
. An inclined plane is a sloped platform that helps us do work.	. Discuss the inclined plane as a simple machine.	Demonstration . Pull an object along a smooth board with a spring balance and read the balance. Elevate one end of the board and pull the object up the board, taking readings on the spring balance with the board in several different positions.

CONCEPTS	CONTENT	ACTIVITIES
. Input work is done by a person and output work is what is accomplished on a machine.	. Discuss and define input and output work.	Laboratory . Have students construct an inclined plane from a smooth board. Using a spring balance to find the force and a meter stick to measure length and height, compute the input and output work.
. The mechanical advantage of a machine tells how much the machine helps a person.	. Define and discuss the mechanical advantage of a machine.	Laboratory . Construct a simple inclined plane and compute the mechanical advantage of it. Test . Devise a test for Chapter 3.

CONCEPTS	CONTENT	ACTIVITIES
		From the Text . Page 56 - Questions 14, 15. . Page 58 - Activities 1.
. A lever is a simple machine.	. Discuss and define levers. Describe the three classes of levers and give examples of each class.	Demonstration . Have students make a list of as many levers as possible, giving the class of each. This should be kept in a notebook. . Use a meter stick and a soft object (such as a sponge) to demonstrate each of the three classes of levers and give the advantage of using each class as a gain or loss in force or distance.
	. Work simple problems using the "principle of torques."	Laboratory . Refer to experiment 4-2, on page 43 in the text. Have students calculate the position of the 200 gram weight before doing the experiment. This will allow them to check their work experimentally.
. A pulley is a simple machine.	. Define and discuss pulleys. Give several examples of how pulleys are used in everyday life. Draw diagrams illustrating how pulleys may be put together as a block and tackle.	

CONCEPTS	CONTENT	ACTIVITIES
. Pulleys can be put together in systems to increase the mechanical advantage.	. Explain that the mechanical advantage of a pulley system may be found by counting the strands of rope supporting the resistance. Use the mechanical advantage to solve simple problems of calculating effort, resistance, or distances.	Laboratory . Set up a pulley system with a mechanical advantage of 6 (3 fixed and 3 movable). Place weights for the resistance and the effort until they balance. Hold the resistance on the table and measure the height of the effort. Place the effort on the table and measure the height of the resistance. See if these values are the same as calculated values.
. A wheel and axle is a simple machine that is very commonly used.	. Discuss the wheel and axle and give several examples of how it is used.	Demonstration . Set up a demonstration model of the wheel and axle. Place weights on it until they balance. Compare the distances that the effort and resistance move to the ratio of the resistance to the effort. Test . Devise a test for Chapter 4.

CONCEPTS	CONTENT	ACTIVITIES
		From the Text . Page 66 - Question 6.
. A jackscrew has a low efficiency but a very high mechanical advantage.	. Discuss the jackscrew as a simple machine, illustrating the resistance, effort, and directions of these forces.	Demonstration . The lifting ability of the jackscrew can be shown by constructing an Archimedian screw (rubber tubing spiralled around a round stick) and demonstrating that it will lift water. . Demonstrate a laboratory model of a jackscrew, if one is available, by lifting a heavy object like a desk or table.
. Force can be transmitted by using a belt system or a system of gears.	. Discuss and illustrate a belt and pulley system. . Discuss and illustrate gears.	Demonstration . Use a bicycle (borrow one from a student) to discuss the transmition of force from your foot to the ground. Activity . Have a student bring the gear box from a car transmition if possible, otherwise, obtain some old gears and demonstrate how they work. Test . Devise a test for Chapter 5.

CONCEPTS	CONTENT	ACTIVITIES
		Film . Story of Illumination, The
. Light is difficult to produce without heat.	. Discuss and explain various types of lighting devices.	Demonstration . Show different types of bulbs and explain how they work.
. The intensity of light decreases with distance.	. Discuss the relationship between intensity of light and distance from a source.	

CONCEPTS	CONTENT	ACTIVITIES
		From the Text . Page 383 - Question 9. Films . Learning About Light . Light - Reflection . Light - Refraction
. Light is a form of energy that travels at 186,000 miles per second.	. Discuss light as a type of energy. Give the approximate speed of light and illustrate the fact that it travels in straingt lines.	Demonstration . Use shadows to show that light travels in straight lines.
. A smooth surface reflects an image.	. Discuss the reflection of light from smooth and rough surfaces. Illustrate what happens in each case on the board.	Demonstration . Place a mirror on a table. Darken the room and shine a beam of light onto the mirror at an angle. Use a protractor to measure the angle of incidence and angle of reflection.
. An image is a reflection of light.	. Discuss images as seen in mirrors.	Demonstration . Use a mirror to show that images seem to be behind the mirror and reversed.
. Light bends as it travels from a medium of one density to a medium of a different density.	. Define and discuss refraction of light. Illustrate on the board and indicate that light changes speed as it travels from one medium to another.	Demonstration . A pencil placed in a beaker of water will appear to be bent. Laboratory . Refer to Experiment 13-3, on page 378 in the text.

CONCEPTS	CONTENT	ACTIVITIES
. A prism will refract light.	. Discuss prisms. Illustrate, on the board, how light is refracted by a prism.	Laboratory . Refer to experiment 31-4, page 379 in the text.
. A lens refracts light to produce an image.	. Discuss lenses. Give several uses of lens and diagram the different types of lenses. Draw diagrams showing the path that light takes as it passes through a lens.	Demonstration . Refer to experiment 31-6, page 382 in the text. Test . Devise a test for Chapters 30 and 31.

CONCEPTS	CONTENT	ACTIVITIES
		From the Text . Page 393 - Questions 7. . Page 394 - Activity 1.
. Optical instruments work similar to a human eye.	. Compare the lens found in a camera and a telescope to that found in the eye. Draw diagrams on the board illustrating that they all have a similar function.	Demonstration . Use an old camera to show the parts and the function of the lens.
. A lens can be used to make an object appear larger.	. Define and discuss magnification. Draw diagrams on the board to illustrate how a lens magnifies.	Laboratory . Have students use several different lens to magnify an object. Have them draw diagrams of the lens and the light rays through them.
. Telescopes are made from mirrors and lenses.	. Discuss optical instrument. Show how a simple astronomical telescope and a reflecting telescope work by using diagrams. Give the parts of the telescope.	Demonstration . Take a telescope or microscope apart to show the parts.
		Test . Devise a test for Chapter 32.

CONCEPTS	CONTENT	ACTIVITIES
		From the Text . Page 401 - Question 5. . Page 402 - Activities 1. Films . Light and Color . Color and Light - An Introduction
. White light is made up of several colors.	. Discuss color and the separating of white light into the spectrum by a prism. Compare this to a rainbow.	Demonstration . Refer to experiment 33-1, page 395 in the text.
. Colored objects absorb some colors and reflect others.	. Discuss color by reflection and absorption of colors. Illustrate how colored filters can remove all colors but one from white light.	Demonstration . Use colored transparent paper to show the effects of filtering light.
. Light waves outside the visible spectrum are called invisible light.	. Define and discuss invisible light.	
		Test . Devise a test for Chapter 33.

CONCEPTS	CONTENT	ACTIVITIES
		From the Text . Page 426 - Question 1. Films . Vibrations . Learning About Sound
. Sound is produced as matter vibrates.	. Discuss the vibrations of matter that produce sound.	Demonstration . Demonstrate that sound is produced by vibrations by stretching a rubber band and vibrating it.
. Echoes are caused when sound waves are reflected.	. Discuss the speed of sound and what causes echoes. . Discuss pitch, frequency and loudness. . Discuss resonance.	Demonstration . Refer to experiment 35-2, page 423 in the text. Test . Devise a test for Chapter 35.

CONCEPTS	CONTENT	ACTIVITIES
		From the Text . Page 455 - Questions 2, 11. . Page 456 - Activities 4.
	. State and discuss Newton's First Law of Motion	
. Newton's Laws predict the motion that is put into by a force.		Demonstration . Place a piece of cardboard over a beaker and place a coin on the cardboard. Thump the cardboard from under the coin, showing that the coin remains in a fixed position. . Quickly jerk a silk scarf from under a beaker of water, illustrating that the beaker remains motionless. . Construct an inertia cart, (Refer to figure 38-1, page 449) and demonstrate Newton's First Law of Motion.
	. State Newton's Second Law of Motion and discuss it by giving several examples of its application.	Demonstration . Show that a rubber band will shoot a small object much faster and farther than it will a large object.
	. State and discuss Newton's Third Law of Motion.	. Have a student stand on a skateboard or skate and throw a heavy object to another student.
. The momentum of matter can be found by multiplying its mass by its velocity.	. Discuss momentum as it applies to matter such as a slow car hitting a tree and a fast car hitting a tree.	. Refer to experiment 38-3, page 452, in the text.
	. Discuss the Universal Law of Gravitation.	Test . Devise a test for Chapter 38.

CONCEPTS	CONTENT	ACTIVITIES
		From the Text . Page 465 - Questions 2, 3. Film . Airplanes and How They Fly 2nd Ed.
. Thrust is a forward force.	. Define and discuss thrust as a force involved in the flight of a plane. Relate this to Newton's Laws of Motion	Demonstration . Refer to experiment 39-1, page 458 in the text.
. Lift is an upward force.	. Define and discuss the "lift" of an airplane and relate this to Newton's Third Law and to Bernoulli's principle.	Demonstration . Refer to experiments 39-2 and 39-3, pages 459 and 460 in the text. . Use the wing from a model airplane to show how life is produced. Draw diagrams on the board to aid in the explanation.
. Drag is a force that tends to slow down an airplane.	. Define and discuss drag as a force that acts upon an airplane. Relate this to sonic booms.	
. A jet engine propells an airplane because of escaping gases.	. Diagram and explain the action of a jet engine. Relate this action to Newton's Third Law.	Demonstration . Blow up a balloon and then release it. Test . Devise a test for Chapter 39.

CONCEPTS	CONTENT	ACTIVITIES
		From the Text . Page 475 - Questions 2, 11, 15 . Page 476 - Activity
. Rockets and jet engines work on the same principle.	. Compare a rocket to a jet airplane. Give the essential differences and likenesses. . Compare the thrust of a rocket to that of a jet plane.	
. A satellite is a small body that orbits a larger one.	. Discuss satellites and the orbits that they are put into. Relate the paths that satellites take to Newton's Laws of Motion.	
		Test . Devise a test for Chapter 40.